

Water Management at the Closed Brenda Mine – Reviewing a Decade of Performance

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OVERVIEW

1. Background, Site History and Key Features
2. Open Pit
3. Rock Stockpiles
4. Plant Site
5. Tailings Impoundment
6. Water Management
7. Summary and Conclusions

Brenda Mine Site

Copper / Molybdenum mine
Located 35 km west of Kelowna

Elevation = 1,500 meters

Footprint of 1300 ha

Operated from 1970 to 1990

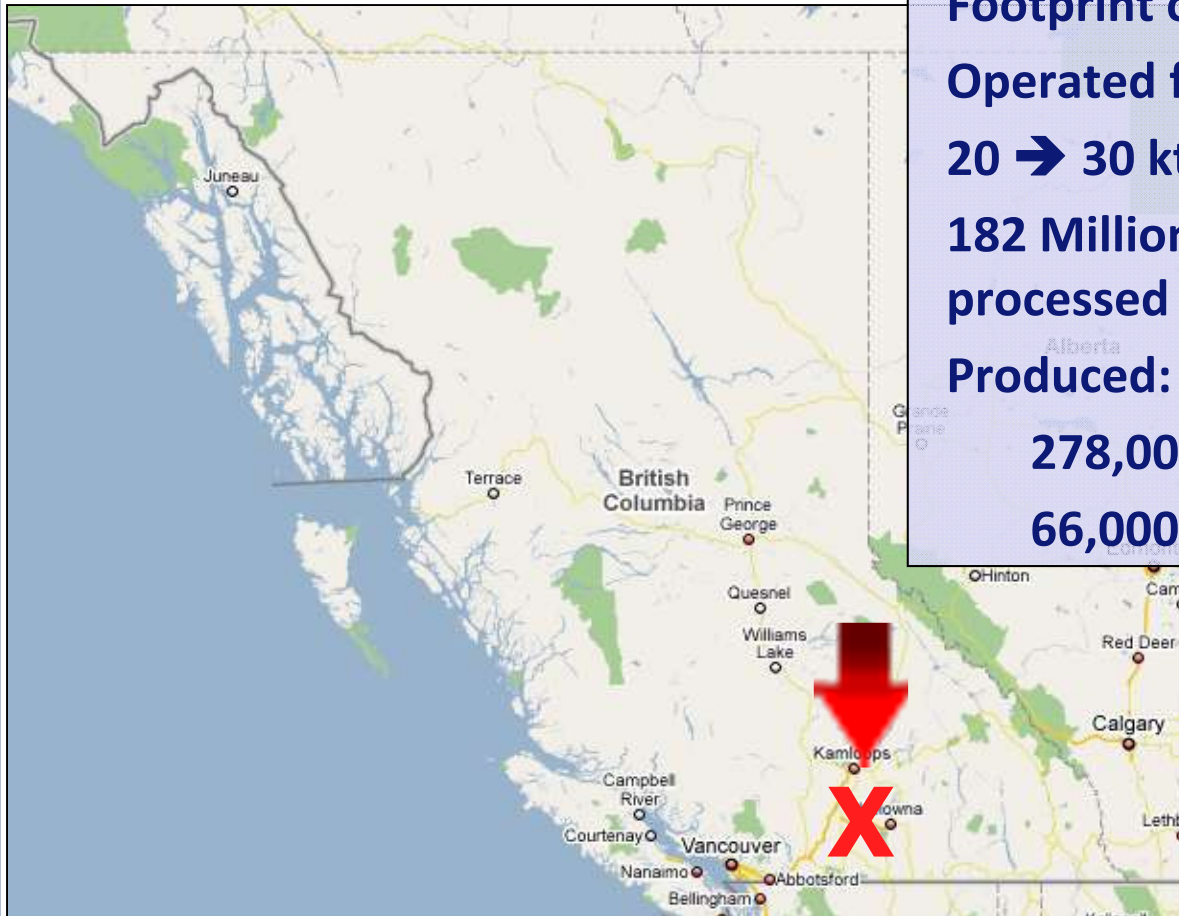
20 → 30 kt/day operation

182 Million tonnes of ore
processed

Produced:

278,000 tonnes of Copper

66,000 tonnes of Molybdenum



Brenda – Overview



Brenda – Open Pit

- 1050 m x 980 m
- maximum depth of 370 m
- Current operating water depth is approx. 160 m or about 33 m below lowest point of pit rim
- Current water storage of about 35 Mm³ with 52 Mm³ capacity



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Brenda – Open Pit



Brenda – Rock Stockpiles

- Four rock piles (N, NE, E and S)
- Approx. 109 Mt
- Built in 20 m lifts
- Stable and suitable for wildlife habitat

Brenda – Rock Stockpiles



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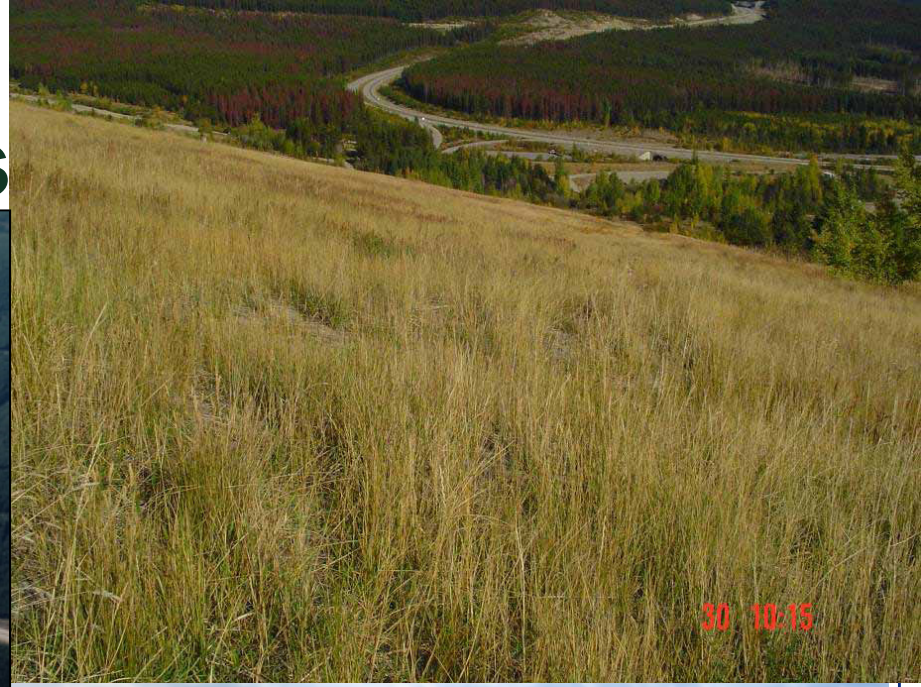


Brenda – Tailings Impoundment

- Approx. 300 ha in area
- Located in former McDonald Creek valley
- Consists of;
 - Main dam – crest is 2 km long
 - Tailings pond
 - Water pumping systems
 - Saddle dam
 - Upper reclaim pond and dam
 - Lower reclaim pond and dam



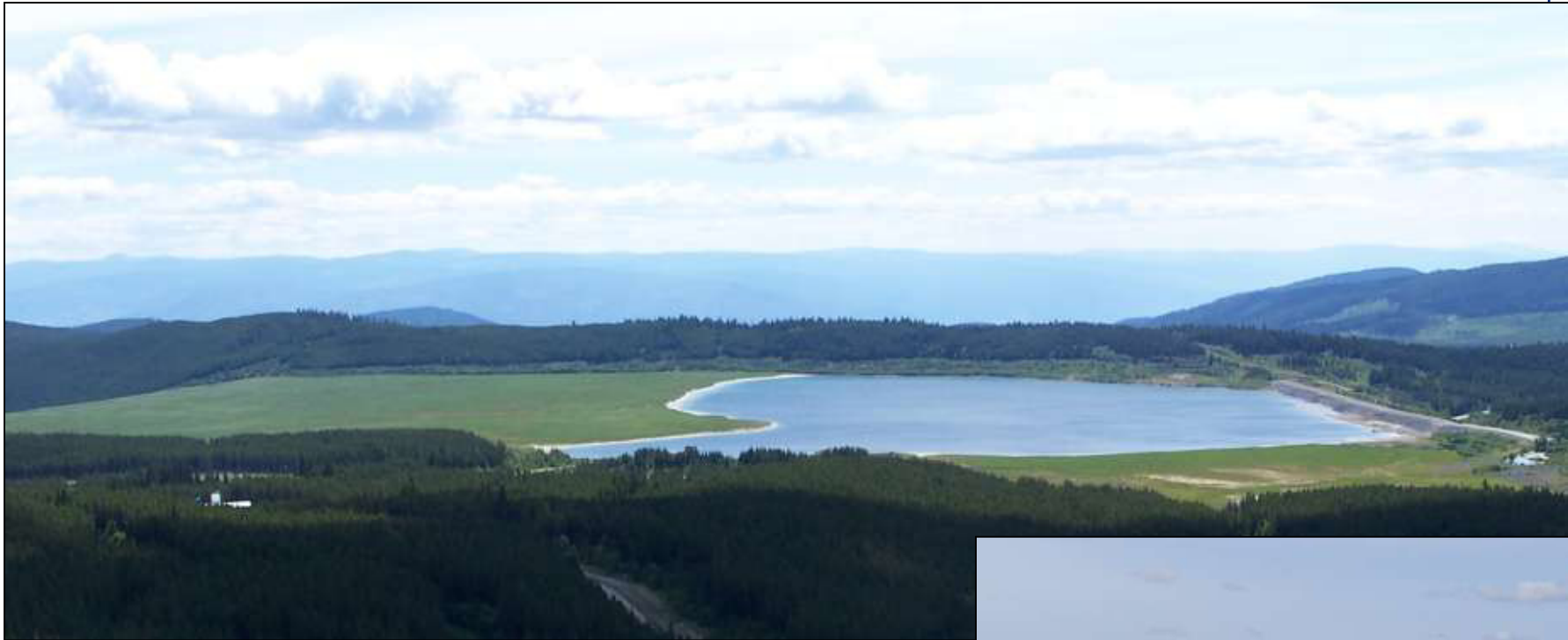
Brenda – Tailings



30 10:15



Brenda – Tailing Impoundment



Brenda – Tailings



- Seepages through dams are contained and sent to the tailings pond to prevent release of untreated water to environment
- Seepage flow rates and quality are monitored

Clean Water Diversion



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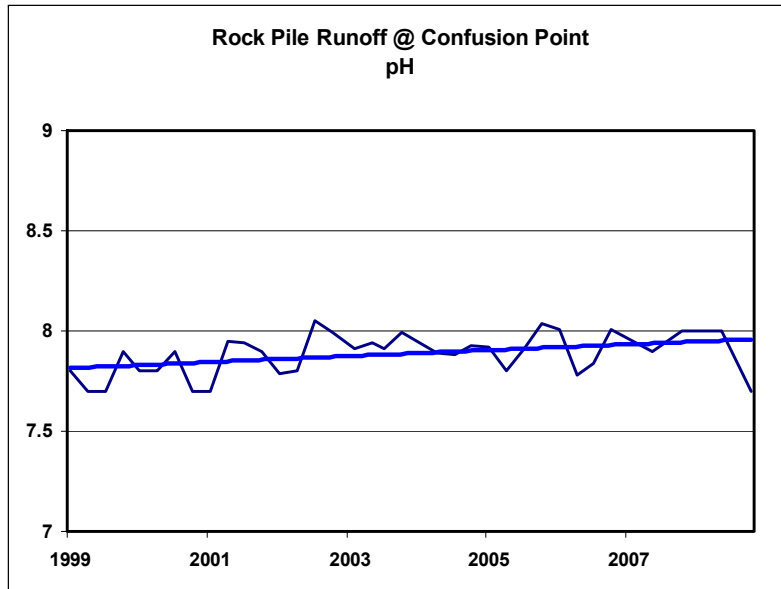


Molybdenum as an Environmental Driver

- Mine rock and tailings are NON-PAG
- Metal leaching - Molybdenum (Mo) was primary concern
- Trepanier Creek used for irrigation near Peachland with municipal water intake
- Molybdenum concern for;
 - uptake in harvested plants
 - local wildlife – especially ruminants
- Less to no concern for fish

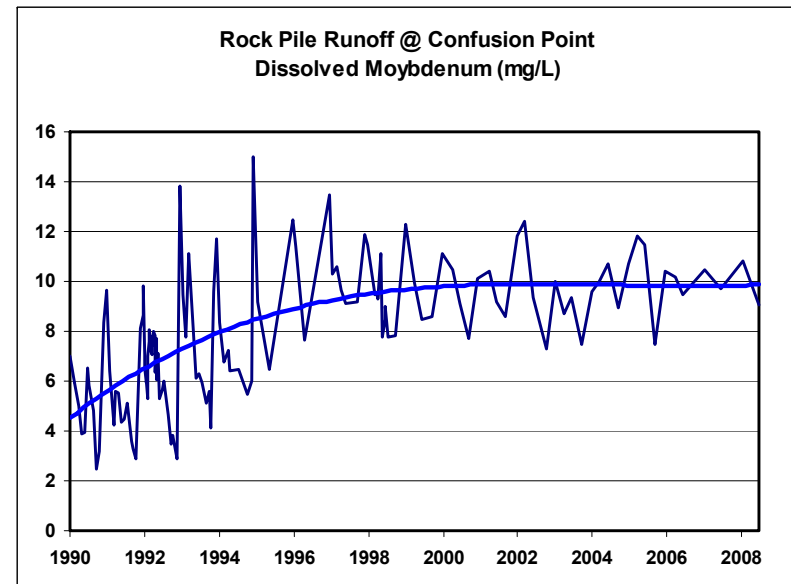


Drainage Quality from Rock Piles



pH

Mo



Closure Plan – The Process

- **Brenda finalized its decommissioning plan in 1993**
 - **Active consultation via two public committees**
 - **technical**
 - **local stakeholders**
- **Three options for water management considered**
 1. Discharge site runoff to MacDonald and Trepanier Creeks without treatment and provide an alternative supply of water for users on Trepanier Creek (Irrigation).
 2. Discharge runoff directly to Okanagan Lake in a pipeline running along the MacDonald and Trepanier Creek.
 3. Seasonal treatment to reduce molybdenum content with seasonal discharge to MacDonald and Trepanier Creeks.
- **Option 3 was selected and an effluent discharge permit was required.**



Brenda – Water Management



Lower reclaim pond looking up to main dam

- Tailings pond and open pit used for active storage of collected water
- Seepage waters collected, returned to tailings pond and treated seasonally before release
- 2 to 3 Mm³ treated annually

Brenda – Water Management

- Average Influent Mo = 2.75 mg/L
- Treatment plant consistently discharges water with concentrations averaging 0.05 mg/L (much lower than permit level of 0.25 mg/L)



Brenda – Water Management

- Water treatment solids (sludge) stored in engineered impoundment in catchment with flow reporting to tailings pond
- Designed to dewater and drain in order to consolidate solids
- Sludge drainage water goes to tailings pond
- Impoundment can be increased in size as required over time and will remain within catchment of tailings pond



Brenda – Water Management

Treatment solids (sludge)
in containment cells



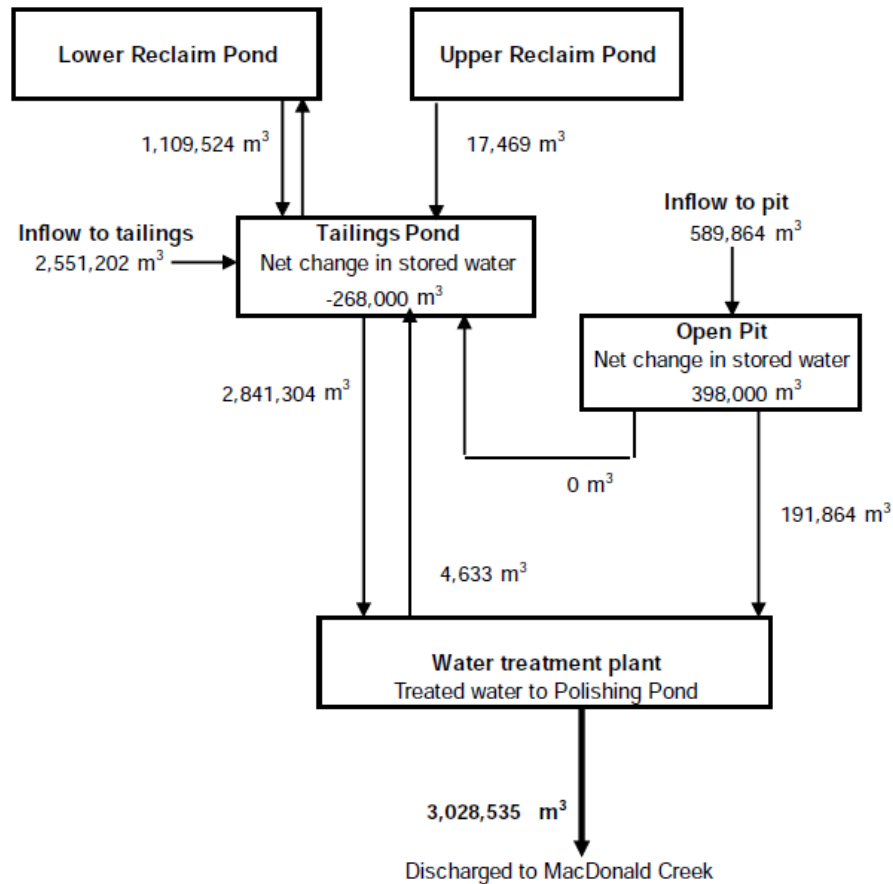
Dewatered
treatment
solids



All seepage reports to tailings pond

Water Management

2011 Water Flows



Site Discharge

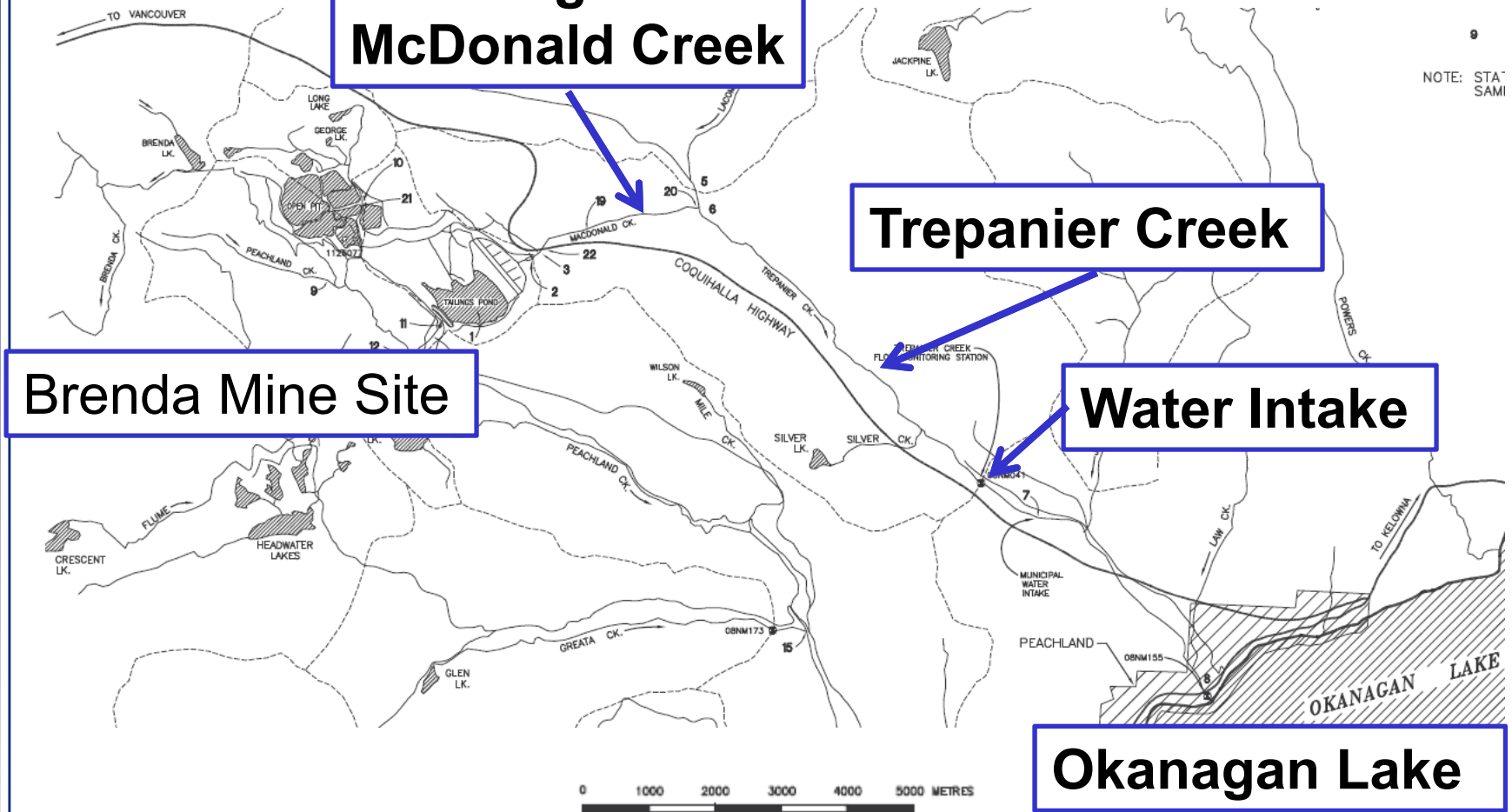
Discharge to
McDonald Creek

Trepanier Creek

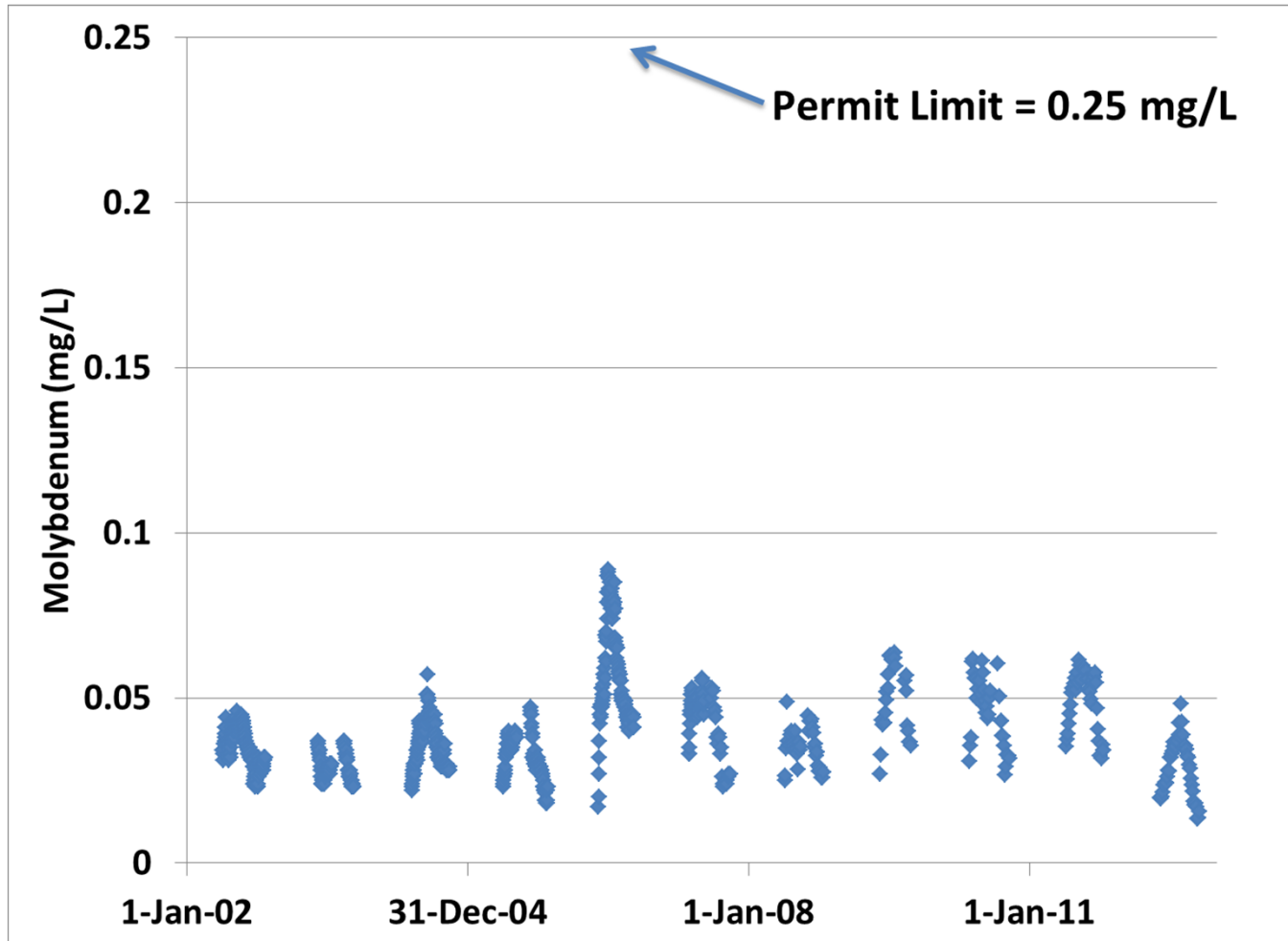
Water Intake

Brenda Mine Site

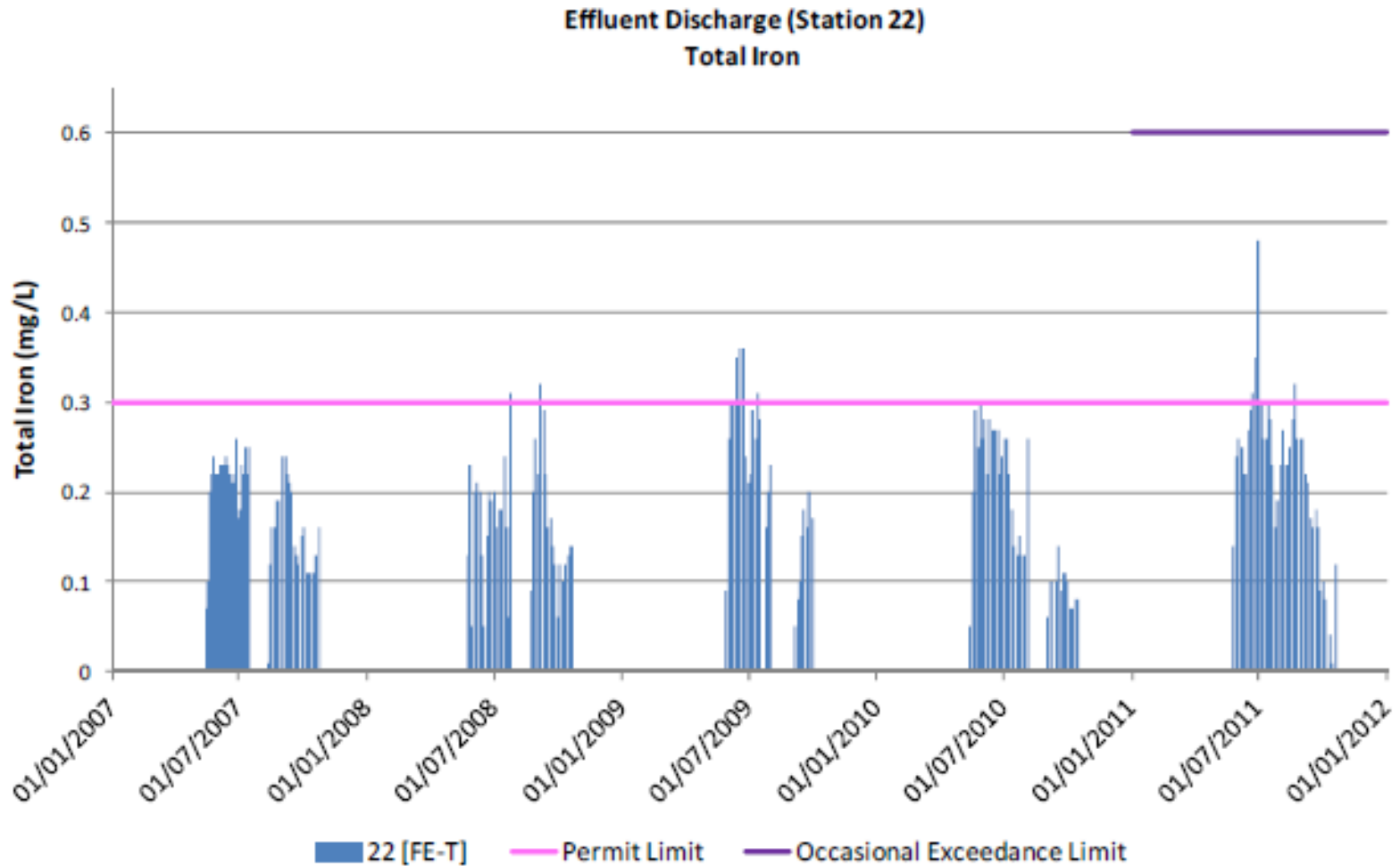
Okanagan Lake



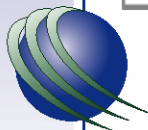
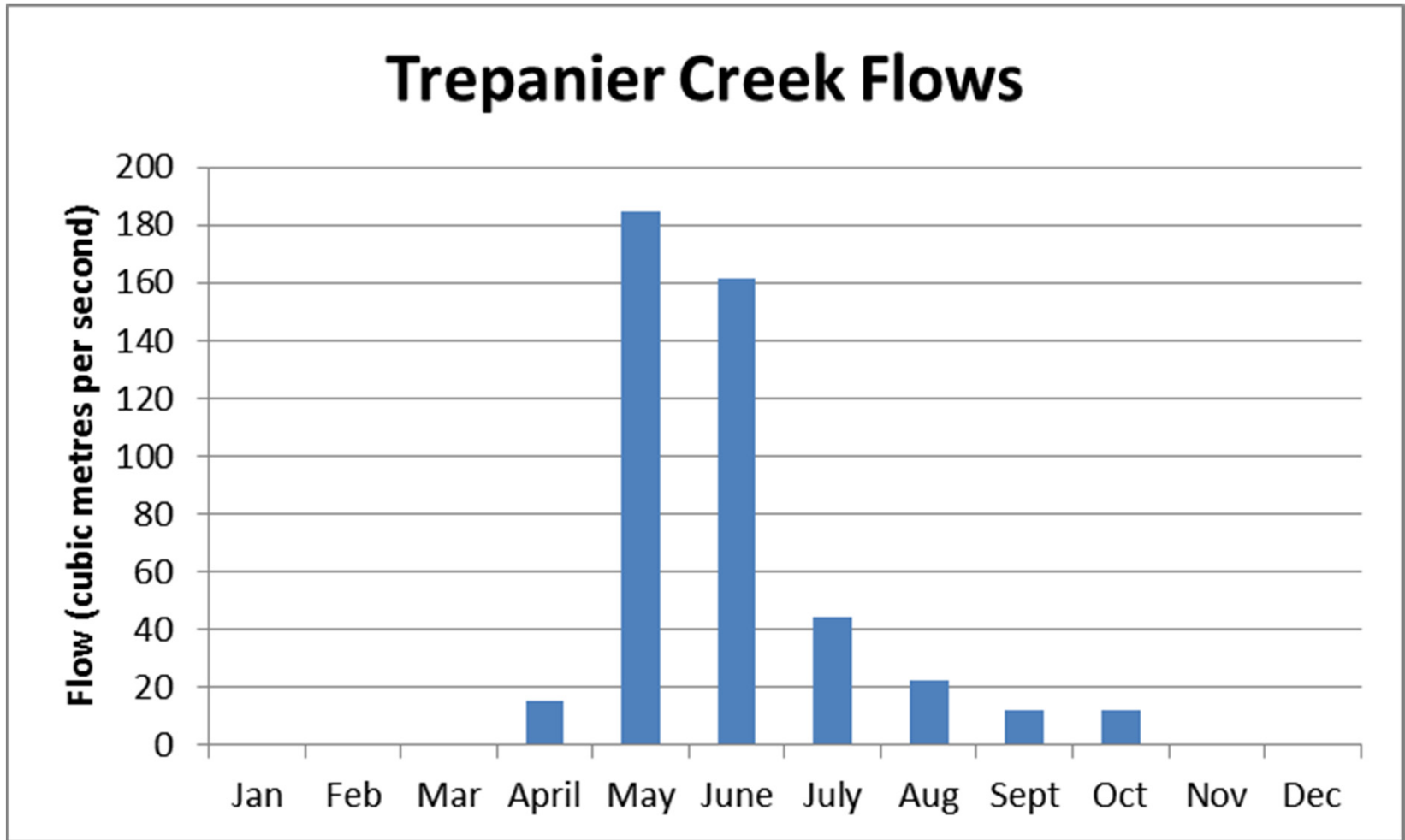
Molybdenum in Treated Effluent



Iron in Effluent

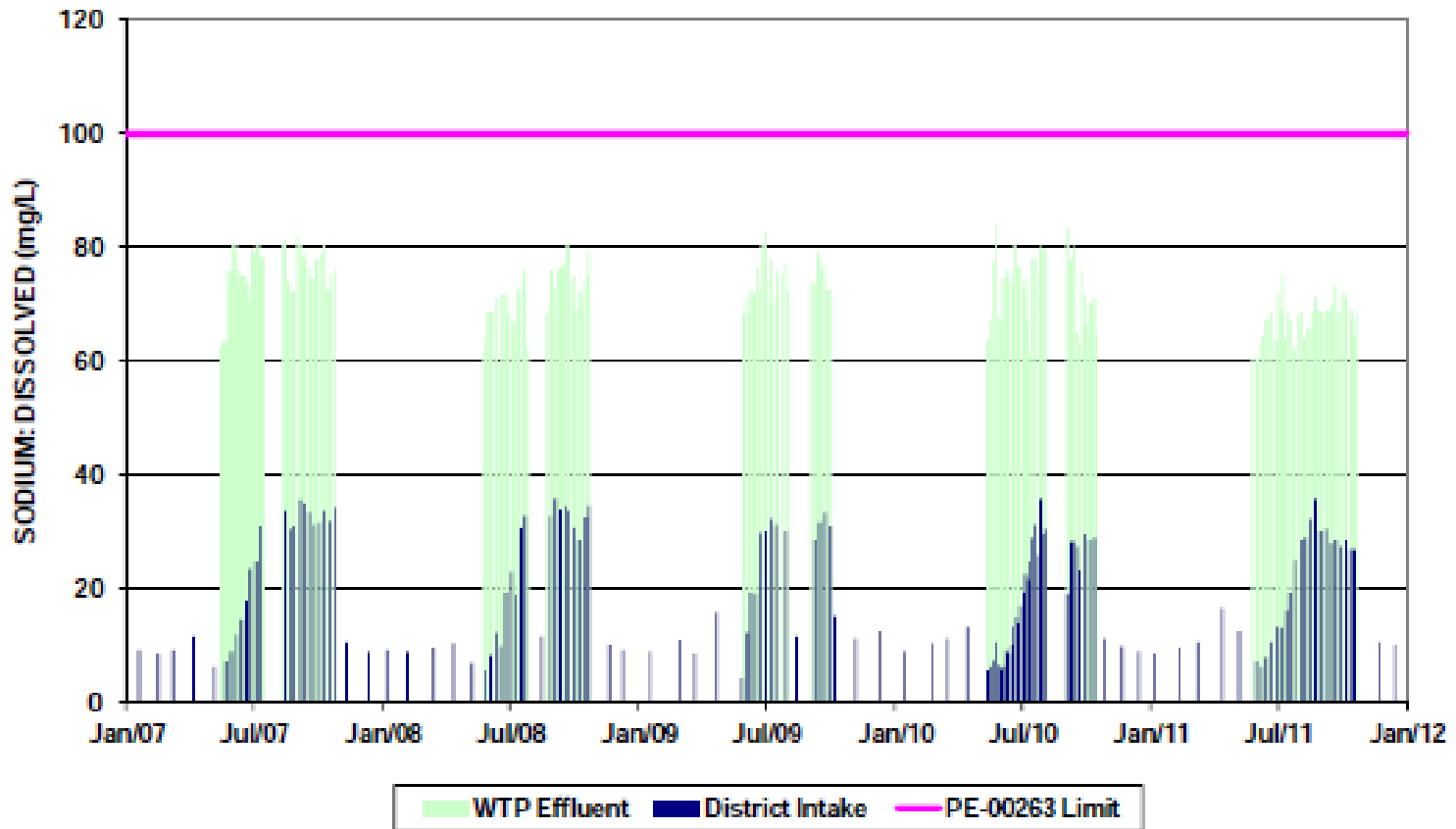


Flow rates in Trepanier Creek



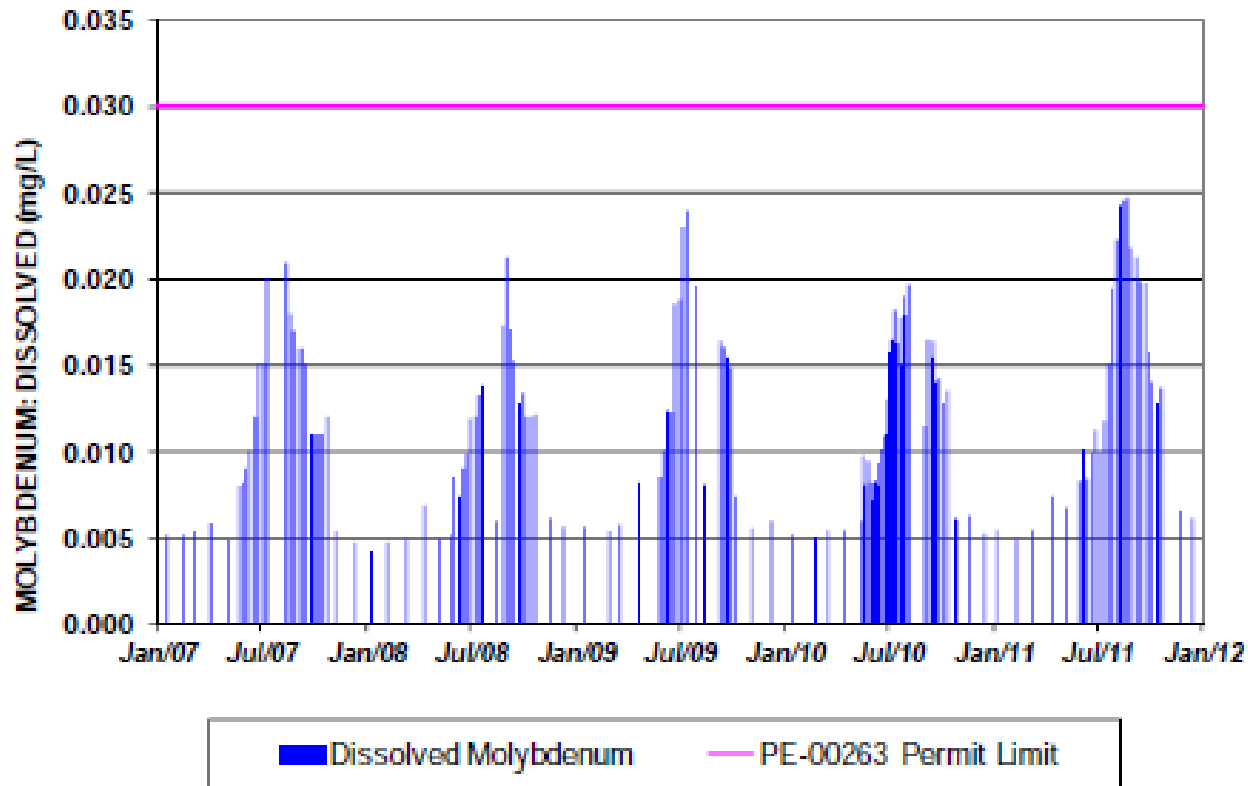
Effluent and Downstream Concentrations of Sodium

Trepanier Creek at District Intake (Station 7) and Effluent Discharge (Station 22)
Dissolved Sodium
2007 through 2011



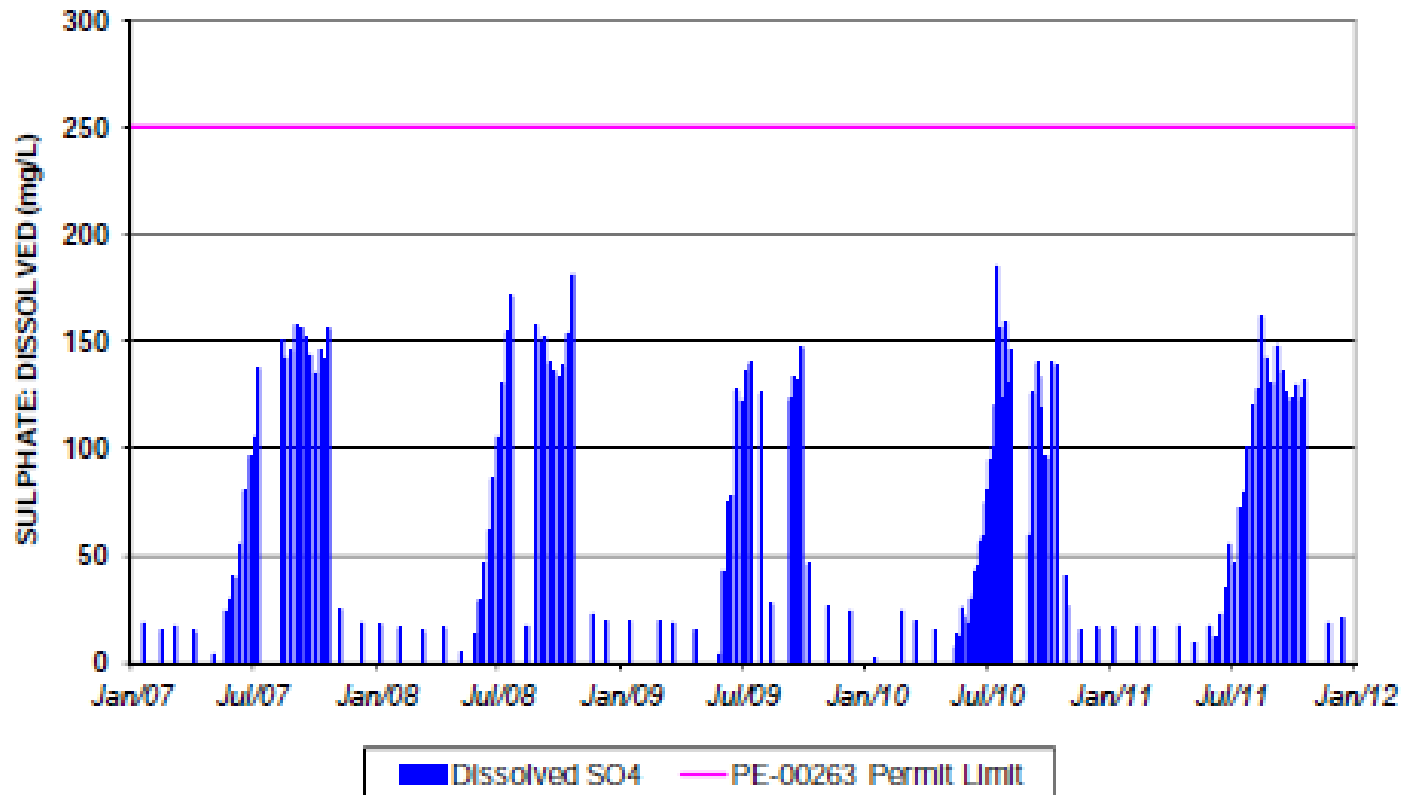
Molybdenum Downstream

Trepanier Creek at District Intake (Station 7)
Dissolved Molybdenum
2007 through 2011



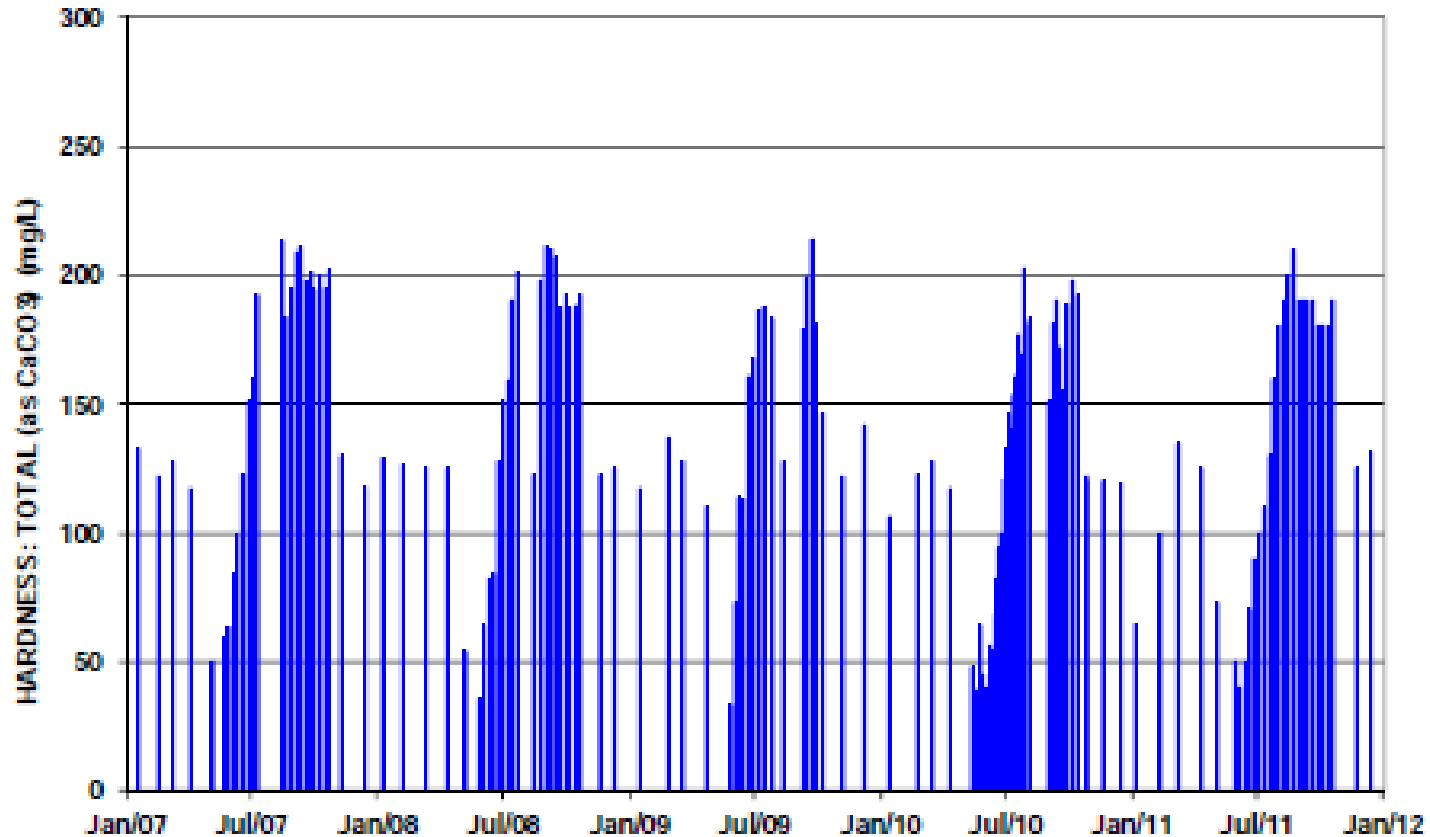
Sulphate Downstream

Trepanier Creek at District Intake (Station 7)
Dissolved Sulphate
2007 through 2011



Hardness Downstream

Trepanier Creek at District Intake (Station 7)
Hardness
2007 through 2011



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Brenda – Wildlife

- Wildlife and vegetation study indicated no adverse effects resulting from molybdenum toxicity in resident deer population (Beak, 2000)
- Ongoing vegetation studies (Golder, 2007) indicate all metals in vegetation within acceptable levels

Brenda - Conclusions

- Water with elevated molybdenum concentrations is effectively managed and treated before release to environment
- Downstream environment shows no signs of adverse effects as demonstrated by two (2) consecutive studies representing more than five (5) years of operation